Associations of self estimated workloads with musculoskeletal symptoms among hospital nurses

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Abstract

***Objectives*—To investigate the prevalence of neck, shoulder, and arm pain (NSAP) as well as low back pain (LBP) among hospital nurses, and to examine the association of work tasks and self estimated risk factors with NSAP and LBP.**

***Methods*—A cross sectional study was carried out in a national university hospital in Japan. Full time registered nurses in the wards (n=314) were selected for analysis. The questionnaire was composed of items on demographic conditions, severity of workloads in actual tasks, self estimated risk factors for fatigue, and musculoskeletal pain in the previous month. Rate ratios (RRs) and 95% confidence intervals (95% CIs) were calculated by the Cox's proportional hazards model to study the association of pain with variables related to work and demographic conditions.**

***Results*—The prevalences of low back, shoulder, neck, and arm pain in the previous month were 54.7%, 42.8%, 31.3%, and 18.6%, respectively. The prevalence of musculoskeletal symptoms among hospital nurses was higher than in previous studies. In the Cox's models for LBP and NSAP, there were no significant associations between musculoskeletal pain and the items related to work and demographic conditions. The RRs for LBP tended to be relatively higher for "accepting emergency patients" and some actual tasks. Some items of self estimated risk factors for fatigue tended to have relatively higher RRs for LBP and NSAP.**

***Conclusions*—It was suggested that musculoskeletal pain among hospital nurses may have associations with some actual tasks and items related to work postures, work control, and work organisation. Further studies, however, are necessary, as clear evidence of this potential association was not shown in the study.**

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Work related musculoskeletal disorders have been described as one of the main health problems among healthcare workers.[1–4] Recently, the physical handling of elderly people has been increasing as society ages. Consequently, physical workloads related to tasks handling people are becoming heavier, raising the possibility of a higher prevalence of serious work related musculoskeletal disorders among healthcare workers.[5–10]

A higher prevalence of low back pain (LBP) has often been shown among healthcare workers, particularly compared with other hospital and industrial workers.[4 5 11–16] Most studies have focused on LBP among healthcare workers, but there are few studies on occupational cervicobrachial disorders or neck, shoulder, and arm pain (NSAP). Handling patients may cause not only LBP but also NSAP,[8 17] as it potentially exerts an excessive burden on the neck, shoulders, and arms.[6 18–21]

Work related musculoskeletal disorders among nurses have been reported to have associations with tasks involved in handling patients, in particular lifting patients,[6 22–24] and have been studied from both the physical and ergonomic viewpoints.[25–33] Optimum patient handling skills have also been developed and proposed for the safety of both nurses and patients.[34 35] Harber *et al* suggested that work related LBP is not associated only with transferring patients,[36 37] and tasks other than patient handling are also considered to be hazardous to musculoskeletal systems,[7] so the necessity of comprehensive task analysis has been emphasised.[21] There are, however, few studies which have surveyed actual workloads and reported the associations between tasks and work related musculoskeletal disorders.[21 38]

Thus, in the present study the prevalence of NSAP and LBP was investigated among hospital nurses. The purpose of this study was to analyse the association between NSAP and LBP and self estimated workloads, and to assess the actual tasks which have strong relations with musculoskeletal symptoms. If the tasks associated with NSAP or LBP could be detected, it would facilitate the planning of efficient and effective preventive strategies by allowing a focus on the main contributing tasks.

Subjects and methods

SUBJECTS

This study was carried out in a national university hospital in Nagoya, Japan. There were 523 nurses and 806 beds in the 19 clinical wards of the hospital. Questionnaires were distributed to 508 eligible nurses after excluding those on leave (maternity, child care, or sick). The authors explained the purpose and contents of the questionnaire to the subjects beforehand, and asked their consent to participate in the study. Most of the nurses who returned the questionnaire (n=457, 90.0%) were women (n=448). Their mean (SD) age

Table 1 Demographic items for registered nurses (n=314)

Demographic items	*Mean (SD)*
Age (y)	29.5 (8.5)
Duration of employment in present ward (y)	1.8 (3.0)
Cumulative duration of professional career (y)	7.7 (8.1)
Height (cm)	156.5 (5.3)
Weight (kg)	50.1 (5.9)
BMI (kg/m^2)	20.5 (2.2)

Table 2 Workplace and some personal characteristics of registered nurses (n=314)

	n (%)
Workplaces:	
Internal medical wards	119 (37.9)
Surgical wards	195 (62.1)
Occupation:	
Head nurses	17 (5.4)
Supervisors	54 (17.2)
Staff nurses	243 (77.4)
Married	76 (24.2)
Have children	52 (16.6)

was 31.6 (10.3) years with a mean (SD) cumulative professional career of 9.1 (9.2) years.

Nursing tasks varied according to where the respondents worked—such as the type of ward, and work in operating rooms, intensive care units, or outpatient units. It also varied with qualifications. There are few nursing assistants in large general hospitals in Japan. The proportion of assistants among nursing workers in the present hospital was <5%. Nurses usually performed patient handling tasks. In this study, we wanted to focus on actual tasks which ward nurses performed for patients in hospital, and the association of those workloads with NSAP or LBP. Thus, full time registered nurses in the wards (n=314) were selected for analysis. Their mean (SD) age was 29.5 (8.5) years with a mean (SD) cumulative professional career of 7.7 (8.1) years (table 1).

QUESTIONNAIRES

A cross sectional study was carried out in July 1994. A questionnaire developed by the authors was given to the subjects and collected 2 weeks later. The questionnaire included items on demographic conditions, severity of workloads in the actual tasks performed, self estimated risk factors for fatigue, and musculoskeletal symptoms present in the previous month.

Demographic items were workplace, age, duration of employment in the present ward, cumulative duration of professional career as a nurse, height and weight, body mass index (BMI), occupational status, marital status, and number of children (tables 1, 2 and 3). The workplaces were classified into surgical wards for operative treatment and internal medical wards for chemotherapy and radiation. Respondents were grouped by occupational status into head nurses or supervisors, and staff nurses. The questionnaire included questions on complaints about 17 actual tasks, not all of which involved handling patients (table 4). The self estimated severity of workloads in actual tasks was categorised into (*a*) heavy, (*b*) moderate, (*c*) light, and (*d*) no such tasks. Then, categories for (*a*) heavy and (*b*) moderate were combined into one for the analysis. Twenty four self estimated risk factors for fatigue were grouped into four dimensions after varimax rotation by factor analysis (table 5). The first factor (factor 1) consisted of nine items suggesting work organisation. Factor 2 consisted of eight items related to work control. Factor 3 was the factor constructed of four items suggesting work postures. Factor 4 was composed of three items suggesting condition of the patients. Each item was dichotomised as either a possible cause or not (table 6). Musculoskeletal symptoms that subjects had had in the previous month included pains in the neck, shoulders, arms, and low back. The severity of the pains was ranked into three grades; continuous if the subject had a pain often or almost every day; occasional if she experienced pain occasionally at least two or three times during the previous month; and seldom or painless. Respondents were asked to select one of the three categories. Subjects with continuous or occasional pain were classified as having pain, whereas those with infrequent or no pain at all were classified as having no pain. This classification was made for pains in the neck, shoulders, arms, and low back.

DATA ANALYSIS

Rate ratios (RRs) and 95% confidence intervals (95% CIs) were calculated by the Cox's proportional hazards model to study the association between pain and demographic items (workplace, age, duration of employment in present ward, height, BMI, and marital status). The cumulative duration of a nurse's professional career and occupational status were omitted from the model to avoid multicollinearity, because those items had a high correlation with age (r=0.98, p<0.0001), (r=0.68, p<0.0001), respectively. Similarly, the number of children was also omitted from the model as it had a high correlation with marital status (r=0.68, p<0.0001). Additionally, weight was omitted from the model, as it had a high correlation with BMI (r=0.82, p<0.0001).

The associations between LBP and NSAP and actual tasks were studied by the Cox's models controlling for workplace, age, duration of employment in present ward, height, BMI, and marital status. The Cox's models were also applied to study the associations of LBP and NSAP with self estimated risk factors for fatigue. In this study, significance was indicated

Table 3 Association of low back pain and neck/shoulder/arm pain with demographic variables in ward nurses (n=314)

Dependent variables	*Independent variables*	*RR*	*95% CI*
Low back pain	Workplace*	1.08	0.85 to 1.36
	Duration of employment in present ward (y)	0.99	0.96 to 1.03
	Age (y)	0.98	0.82 to 1.18
	Height (cm)	1.07	0.86 to 1.33
	BMI (kg/m^2)	1.02	0.97 to 1.07
	Marital state†	1.10	0.80 to 1.50
Neck, shoulder, or arm pain	Workplace*	1.04	0.82 to 1.3
	Duration of employment in present ward (y)	0.99	0.96 to 1.03
	Age (y)	0.97	0.81 to 1.16
	Height (cm)	0.96	0.77 to 1.20
	BMI (kg/m^2)	1.02	0.96 to 1.07
	Marital state†	1.10	0.80 to 1.51

RRs (95% CIs) were calculated by the Cox's model. RRs were calculated by postulating the differences of 10 years for age and 10 cm for height.
*Workplace: 0=internal medical wards, 1=surgical wards.
†Marital state: 0=unmarried, 1=married.

Table 4 Association of low back pain and neck, shoulder, or arm pain with complaints of actual tasks (n=314)

Independent variables (actual tasks)	*Responses*		*Low back pain RR (95% CI)*	*Neck/shoulder/arm pain RR (95% CI)*
	Yes	*No*		
Accepting emergency patient	252	30	1.29 (0.88 to 1.90)	1.09 (0.74 to 1.60)
Transferring patient	198	101	1.14 (0.89 to 1.45)	1.10 (0.86 to 1.40)
Moving beds	233	73	1.13 (0.86 to 1.49)	1.16 (0.88 to 1.52)
Helping patient to bathe	218	57	1.11 (0.82 to 1.50)	1.16 (0.86 to 1.57)
Helping patient to shampoo	199	43	1.10 (0.79 to 1.55)	1.17 (0.83 to 1.65)
Changing incontinance pads	214	85	1.10 (0.85 to 1.43)	1.06 (0.82 to 1.38)
Repositioning patient in bed	158	138	1.10 (0.86 to 1.40)	0.98 (0.77 to 1.25)
Bed bath	176	123	1.08 (0.85 to 1.37)	1.05 (0.82 to 1.34)
Medication	83	215	1.09 (0.84 to 1.42)	1.05 (0.81 to 1.37)
Care of patient with serious disabilities	261	39	1.07 (0.76 to 1.51)	0.98 (0.69 to 1.39)
Taking patient to an operation room and receiving	198	93	1.05 (0.81 to 1.36)	1.04 (0.81 to 1.35)
Feeding bedridden patient	129	147	1.04 (0.82 to 1.33)	1.05 (0.83 to 1.35)
Undressing patient	132	170	1.03 (0.82 to 1.31)	1.03 (0.82 to 1.31)
Treating a dead body	211	52	1.03 (0.76 to 1.40)	1.01 (0.74 to 1.37)
Sending patient to an exam and receiving	166	135	1.01 (0.80 to 1.28)	1.10 (0.87 to 1.39)
Making bed	269	40	1.00 (0.71 to 1.43)	1.02 (0.72 to 1.44)
Helping incoming or discharged patient	163	128	0.98 (0.77 to 1.24)	1.12 (0.89 to 1.43)

RRs (95% CIs) were calculated by the Cox's model by controlling for workplaces, duration of employment in present ward, age, height, BMI, and marital state.

by the lower limit of the 95% CI of the RR >1.0. The RRs in the Cox's model were calculated with the statistical analysis system (SAS) in the mainframe (M-1800/20, Fujitsu, Japan) at the Computation Centre of Nagoya University.

Results

The prevalences of pain in the low back, shoulder, neck, and arm in the previous month were 54.7%, 42.8%, 31.3%, and 18.6%, respectively. In the Cox's models, LBP and NSAP had no significant associations with demographic variables (table 3). There were also no significant associations between musculoskeletal pains and actual tasks or self estimated risk factors for fatigue in the Cox's models for LBP and NSAP controlling for demographic variables (tables 4 and 6). The RRs for LBP when accepting emergency patients and transferring patients were 1.29 and 1.14, respectively, which tended to be higher than those for other tasks, although the lower limits of their 95% CI were not >1.0 (table 4). Similarly, RRs of NSAP for moving beds, helping patients to bathe, and helping patients to shampoo tended to be higher. Relatively higher RRs for LBP were also noted for items that suggested work postures including frequent bending forward or half sitting, much static work, and frequent lifting and handling of objects (table 6). The items suggesting control of one's own work—such as much unplanned work and difficulties in lowering workloads at reduced working capacity also tended to have relatively higher RRs for LBP. Among the items suggesting work organisation, RRs for LBP and NSAP tended to be slightly higher for extra work due to poor physical condition of colleagues.

Discussion

PREVALENCE

The prevalence of LBP (54.7%) in the previous month was the highest in the four body regions neck, shoulders, arms, and low back. These

Table 5 Factor pattern of self estimated risk factors for fatigue in the workplace by factor analysis with varimax rotation (n=314)

	Factor loading			
	Factor 1	*Factor 2*	*Factor 3*	*Factor 4*
Frequent bending forward or half sitting	0.182	0.124	0.688	0.090
Much static work posture	0.155	0.033	0.742	0.138
Frequent lifting and handling of objects	0.034	0.179	0.729	0.172
Frequent repetitive work with shoulders, arms, hands, or fingers	0.349	0.151	0.474	0.134
Much unplanned work	0.159	0.371	0.307	0.342
Difficulties in lowering work load at reduced working capacity	0.325	0.417	0.241	0.313
Too many different tasks	0.116	0.484	0.276	0.264
Too much responsibility	0.193	0.703	0.132	0.161
Too much work	0.175	0.591	0.386	0.390
Shortage of staff	0.239	0.353	0.145	0.338
Great time pressure	0.154	0.665	0.083	0.251
Much concentration required	0.248	0.549	0.030	0.009
Extra work due to poor physical condition of colleagues	0.423	0.219	0.155	0.121
Work after sick leave, maternity leave, and childcare leave	0.598	0.085	0.204	0.307
Difficulties in acting on one's own ideas	0.728	0.229	0.100	0.135
Difficult human relations at work	0.612	0.301	0.189	0.083
Lack of frank discussion about work problems	0.752	0.282	0.031	0.022
Responsibilities other than tasks at work	0.475	0.159	0.083	0.286
Role ambiguity in the workplace	0.828	0.051	0.197	0.114
Inexperienced in handling tasks	0.496	0.074	0.077	0.178
Many admissions and discharges	0.452	0.229	0.137	0.367
Many patients with serious disabilities	0.205	0.371	0.292	0.684
Many patients with a sudden change in condition	0.283	0.328	0.207	0.755
Many admissions with emergencies	0.517	0.152	0.152	0.579

Table 6 Association of low back pain and neck, shoulder, or arm pain with self estimated risk factors for fatigue in the workplace (n=314)

Factors	Independent variables (self estimated risk factors for fatigue)	Responses		Low back pain RR (95% CI)	Neck, shoulder, or arm pain RR (95% CI)
		Yes	No		
Work postures	Frequent bending forward or half sitting	238	66	1.29 (0.97 to 1.70)	1.08 (0.82 to 1.43)
	Much static work posture	220	81	1.20 (0.93 to 1.55)	1.08 (0.83 to 1.40)
	Frequent lifting and handling of objects	248	58	1.16 (0.87 to 1.55)	1.00 (0.74 to 1.34)
	Frequent repetitive work using shoulders, arms, hands or fingers	146	159	1.08 (0.86 to 1.36)	1.09 (0.86 to 1.37)
Work control	Much unplanned work	243	64	1.17 (0.88 to 1.55)	1.04 (0.78 to 1.38)
	Difficulties in lowering work load at reduced working capacity	233	73	1.14 (0.87 to 1.50)	1.02 (0.78 to 1.34)
	Too many different tasks	217	88	1.11 (0.86 to 1.43)	0.99 (0.77 to 1.28)
	Too much responsibility	253	54	1.11 (0.82 to 1.50)	0.91 (0.67 to 1.23)
	Too much work	225	80	1.11 (0.85 to 1.44)	0.95 (0.73 to 1.24)
	Shortage of staff	245	61	1.06 (0.79 to 1.41)	1.07 (0.80 to 1.43)
	Great time pressure	252	54	1.05 (0.78 to 1.42)	0.93 (0.69 to 1.25)
	Much concentration required	277	32	0.92 (0.63 to 1.34)	0.87 (0.60 to 1.28)
Work organisation	Extra work due to poor physical condition of colleagues	136	168	1.14 (0.90 to 1.44)	1.12 (0.89 to 1.42)
	Work after sick leave, maternity leave, and childcare leave	133	117	1.04 (0.80 to 1.35)	0.98 (0.76 to 1.27)
	Difficulties in acting on one's own ideas	164	140	1.03 (0.82 to 1.30)	1.05 (0.83 to 1.32)
	Difficult human relations at work	171	132	1.01 (0.80 to 1.27)	0.99 (0.78 to 1.25)
	Lack of frank discussion about work problems	166	136	1.02 (0.81 to 1.29)	1.00 (0.79 to 1.26)
	Responsibilities other than tasks at work	157	128	1.00 (0.79 to 1.27)	1.05 (0.83 to 1.33)
	Role ambiguity in the workplace	143	162	0.97 (0.77 to 1.22)	1.02 (0.80 to 1.28)
	Inexperienced in handling tasks	195	112	0.89 (0.69 to 1.15)	0.94 (0.73 to 1.21)
	Many admissions and discharges	164	138	0.89 (0.70 to 1.12)	1.02 (0.81 to 1.28)
Patient conditions	Many patients with serious disabilities	205	95	1.11 (0.87 to 1.42)	0.98 (0.76 to 1.25)
	Many patients with a sudden change in condition	181	111	1.09 (0.85 to 1.38)	0.99 (0.77 to 1.25)
	Many admissions with emergencies	159	129	1.02 (0.81 to 1.30)	1.02 (0.80 to 1.29)

RRs (95% CIs) were calculated by the Cox's model by controlling for workplace, duration of employment in present ward, age, height, BMI, and marital state.

were also higher than in some other studies.[3 5 24 39 40] Stubbs *et al* found that the annual prevalence of LBP among nurses was about 45% in England and Wales.[3] Investigators in northern European countries have found prevalences of LBP of 40%–50%.[5 39 40] Larese *et al* reported that 48% of the nursing staff of an urban general hospital in Italy had back pain related to work in the previous year.[40] In our study, the prevalence of shoulder pain was 42.8%, which ranked second after LBP, followed by neck pain (31.3%), and arm pain (18.6%). These prevalences were higher than those in a study on nursing homes in The Netherlands by Engels *et al*, where the percentages of nurses with complaints about the neck, shoulders or upper arms and elbows or forearms were 27%, 22%, and 3%, respectively.[7] Lagerström *et al* surveyed 821 hospital nurses in Sweden, with prevalences of self reported ongoing musculoskeletal symptoms in the neck, shoulders, low back, hands, and knees of 48%, 53%, 56%, 22%, and 30%, respectively.[19] The prevalences in their study, however, are not comparable with ours, as they included diverse musculoskeletal symptoms other than pain. Direct comparisons between those studies are difficult as different populations were examined with various methods. Our study, however, suggests that the prevalence of musculoskeletal symptoms among hospital nurses in this survey might be higher than in most previous reports.

POTENTIAL RISK FACTORS

Demographic items

In the study sample, there were no significant associations between musculoskeletal symptoms and the demographic items of workplace, age, duration of employment in present ward, height, BMI, and marital status. This agrees with a prospective study by Mostardi *et al*, which found that variables related to strength and demographics were poor predictors of back injury among female nurses.[32] Other studies have also reported poor associations between demographic items and musculoskeletal symptoms.[19 41] However, other studies reported the opposite, with significant associations between them.[42–44] Thus, further studies need to be carried out after reviewing these conflicting results and analysing the reasons for the disparities.

Actual tasks

Although no significant associations were found between musculoskeletal pain and actual tasks, some tasks such as accepting emergency patients, transferring patients, moving beds, helping patients to bathe, and helping patients to shampoo had relatively higher RRs for many tasks. There are few studies reporting an association between LBP and accepting emergency patients. Bongers *et al*, however, suggested a relation between time pressure and the musculoskeletal symptoms of workers.[45] They postulated that time pressure may increase the number of hurried movements with quick accelerations or poor postures, thereby intensifying the mechanical load on workers. In accepting emergency patients, immediate treatment and resulting demands on quick responses from nurses in sending patients to operating or examination rooms often force them to assume unnatural postures.

In several studies, transferring patients has been reported to be associated with LBP.[6 30 31 43 46–49] Owen *et al* showed that transferring patients from an origin to a destination was ranked the most stressful task among nursing assistants.[6] To reduce the stress on the nurse's back, Garg *et al* tried biomechanical and ergonomic evaluations of manual handling techniques and mechanical hoists for transferring patients.[30 31] However, mechanical hoists for transferring patients are not broadly available in general hospitals in Japan, perhaps due to the long operating time and cost of the hoists. Although many researchers have reported an association between LBP and tasks

involving transfer of patients,[6 22–28] preventive measures to reduce the workload during this task are not effectively implemented in many hospitals.

Similarly, the associations between some tasks and relatively higher RRs of musculoskeletal pains may be supported by previous studies as is the case for accepting emergency patients and transferring patients. Those associations, however, should be studied further as our study has not produced clear evidence.

Work postures

In the present study, many items related to work postures tended to have relatively higher RRs of LBP. Work posture is one of the factors which have been reported as having an association with LBP in many previous studies.[6 10 26 38 50–52] Hignett reported that in wards of elderly people a significantly greater percentage of harmful postures were assumed in handling patients than in tasks not handling patients.[10] Patient handling tasks were often accompanied by static, awkward, bending forward, or half sitting postures, and asymmetric lifting (regarded as a risk factor for back disorders).[49 51 53–56] Thus, the suggestion about work posture and LBP in this study may be considered consistent with recent knowledge of work related musculoskeletal disorders.

Work control

Some items related to work control, including much unplanned work and difficulties in lowering workloads at reduced working capacity, tended to have relatively higher RRs for LBP. As nurses in hospital wards often have much unplanned work, as something unexpected may happen suddenly with any of the patients, controlling the amount of work is difficult. Even if nurses are not in very good physical condition, it is difficult for them to reduce the number of tasks. Nurses cannot usually put off handling patients for several hours, as patients must not be kept in dangerous or uncomfortable situations. Thus, the occurrence of musculoskeletal disorders may be influenced by the stress due to difficulties in controlling the amount of the work, regardless of the nurse's physical condition.

Work organisation

The item extra work due to poor physical condition of colleagues tended to have relatively higher RRs for LBP or NSAP. If some nurses are in poor physical condition or suddenly absent on sick leave, their colleagues have to work harder to take care of all the team tasks with a reduced number of workers. Then, the patient care procedures must be done more hurriedly by nurses on the reduced staff. Nurses therefore often force themselves to go to work despite their poor physical condition, as they are afraid of intensifying the workload of their colleagues by their absence.

LIMITATIONS

As negative results do not always mean no effect or information,[57] possible effects of some items with relatively higher RRs of LBP or NSAP were discussed in this study. Potential effects of those items were suggested, which, however, should be validated before planning preventive measures by further studies with larger samples and diverse epidemiological designs.

As demographic items were adjusted in the Cox's model used to analyse the relations between musculoskeletal pain and actual tasks or self estimated risk factors for fatigue, the influence of some confounders could be avoided. The study design, however, was cross sectional, and the temporal causal relations of these factors to outcomes could not be established. In this study, subjective musculoskeletal symptoms were investigated without carrying out physical examinations. Variables for tasks and risk factors for fatigue also depended on self estimated answers only. Hence, the relation between independent and dependent variables may be subject to the general dissatisfaction of workers or their readiness to report complaints,[45] which might have led to an overestimation of the effects of tasks and risk factors for pain.

Conclusions

The prevalence of pains in the neck, shoulders, arms, and low back in the previous month was studied among nurses working on wards in a national university hospital in Japan. The prevalence of low back pain was the highest. Musculoskeletal pain in this study was more prevalent than pain in most other studies. In the Cox's model for LBP and NSAP after controlling for demographic variables, there were no significant associations between musculoskeletal pain and actual tasks or self estimated risk factors. The RRs of LBP for accepting emergency patients and some actual tasks, however, tended to be high. Some items of self estimated risk factors for fatigue tended to have relatively higher RRs for LBP and NSAP. Thus, it was suggested that musculoskeletal pain among hospital nurses may be associated with some actual tasks and items related to work postures, work control, and work organisation. Further studies, however, are necessary, because our study did not show clear evidence of this potential association.

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